A1258-1
11/8/88

NOVEMBER 7, 1988

CHEMICAL & ENGINEERING NEWS

Real-time laser techniques study transition states
Page 24

0511179C099 9 K AR6645SL 1
CONGRESSIONAL INFO SERV-SRI
4520 EAST WEST HWY SUITE 800
SRI ACQUISITIONS
BETHESDA MD 20814

CHEMICAL & ENGINEERING
NEWS

Volume 66, Number 45
CENEAR 66 (45) 1–68
ISSN 0009-2347

NOVEMBER 7, 1988

News of the Week

■ **Japan's chemical industry targets global integration for next century, sees electronics and biotechnology as major growth areas.** Page 4

■ **AAAS report finds Reagan Administration's R&D policies consistent over eight years, accomplishing most of what the Administration set out to do.** Page 5

■ **BP Chemicals considers switch from naphtha to North Sea liquefied petroleum gas as ethylene source.** Page 5

■ **Sigma Xi survey draws portrait of U.S. research scientists and their views on scientific and societal issues.** Page 6

Business

Many chemical companies are revising their compensation packages in effort to better motivate, as well as retain, experienced personnel. Page 8

Chemical industry should hold off making any concessions on tariffs at the GATT talks in Montreal next month, chemical trade adviser office recommends. Page 13

Government

The second phase of California's toxic chemicals law, which governs toxics' discharge into drinking water supplies, went into effect last week. Page 15

Technology

Prospects for offshore mineral mining remain clouded by factors that include high startup costs, depressed metals markets, restrictive regulations, and turf disputes. Page 18

Awards

ACS award winners: Aczel, Anderson, Anson, Bartlett, Barton, Chandler, Chisholm, and Doering. Page 44

Cover: Part of the femtosecond laser facility at California Institute of Technology. Photo courtesy of Jet Propulsion Laboratory

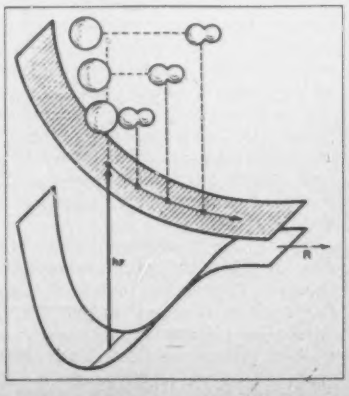
Letters 2

Concentrates

Business 7
Government 14
Science/Technology 17

The Department

Newscripts 68



Special Report

Chemistry on the femtosecond time scale is addressing the chemical dynamics concerned with the very act of chemical transformation, the process of breaking one chemical bond and making another. Page 24

Chemical & Engineering News

1155—16th St., N.W., Washington, D.C. 20036

Editor: Michael Heylin

Assistant Managing Editors: David M. Kiefer, James H. Krieger, Janice R. Long, Donald J. Soisson, William J. Storck. **News Editor:** Wilbert C. Lepkowski

Staff Editor: Ernest L. Carpenter

Senior Editors: New York: Earl V. Anderson, Stephen C. Stinson; Chicago: Joseph Haggin; Washington: Doron Dagani, Lois R. Ember, Rebecca L. Rawls, Pamela S. Zurer

Associate Editors: Stuart A. Borman, Mairin B. Brennan, Bette Hileman, Richard J. Seltzer

Service Departments Editor: Dolores Miner

Editing Services: Anne Riesberg (Head), Arlene Goldberg-Gist (Editorial Assistant), Patricia Oates (Administrative Assistant)

News Bureaus: Northeast News Bureau: (201) 906-8300 Marc S. Reisch (Assistant Editor), Ann M. Thayer (Assistant Editor), Rachel Eskenazi (Administrative Assistant). Chicago: (312) 256-4143 Ward Worthy (Head). Houston: (713) 973-8161 Bruce F. Greek (Head). Washington: (202) 872-4495 David J. Hanson (Head). West Coast: (415) 653-3630 Rudy M. Baum (Head). **Foreign Bureau:** London: (01) 540-0414 Dermot A. O'Sullivan (Head), Patricia L. Layman (Associate Editor)

Graphics and Production: Leroy Corcoran (Manager). Alan Kahan (Art Director). Barbara Fryer (Production/Art Director). Linda Mattingly (Staff Artist). Diane Kelly (Costing). **Business Manager:** Arthur Poulos

Circulation Development: Claud K. Robinson

ADVISORY BOARD: William J. Bailey, Jacqueline K. Barton, Ernest H. Drew, Harry G. Drickamer, A. Nicholas Filippello, Vincent L. Gregory Jr., Adam Heller, John D. Holmfeld, Isabella Karle, Koji Nakanishi, Richard Nicholson, Howard A. Schneiderman, Ellen K. Silbergeld, Howard E. Simmons, Robert M. Simon, William P. Slichter

Published by
AMERICAN CHEMICAL SOCIETY
(202) 872-4600 TDD (202) 872-8733
John K Crum, Executive Director

PUBLISHING BOARD: Ned D. Heindel (*Chairman*); *Board of Directors Chairman:* Ernest L. Eliel; *President:* Gordon L. Nelson; John H. Nelson, Louis D. Quin; Jean'ne M. Shreeve; and Barbara G. Wood

© Copyright 1988, American Chemical Society

Subscription & Member Record Service: Send all new and renewal subscriptions with payments to: Controller, ACS, P.O. Box 28597, Central Station, Washington, D.C. 20005. Correspondence and telephone calls for changes of address, claims for missing issues, subscription service, status of records and accounts should be directed to: Manager, Membership & Subscription Services, ACS, P.O. Box 3337, Columbus, Ohio 43210; (614) 421-3776.

For changes of address, include both old and new addresses with ZIP code numbers and mailing label from a recent issue. Allow four weeks for change to become effective. Claims for missing numbers will not be allowed if loss was due to failure of notice of change of address to be received in the time specified; if claim is dated (a) North America: more than 90 days beyond issue date, (b) all other foreign; more than one year beyond issue date; or if the reason given is "missing from files."

Subscription Rates 1988. Printed editions: nonmembers U.S. 1 yr. $49, 2 yr. $83, outside U.S. 1 yr. $75, 2 yr. $135. Air freight rates available on request. Rates above do not apply to nonmember subscribers in Japan, who must enter subscription orders with Maruzen Co. Ltd., 3-10 Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan. Tel: (03) 272-7211. Single copies: Current $7.00. Rates for back issues and volumes are available from Microforms & Back Issues Office, ACS, 1155—16th St., N.W., Washington, D.C. 20036. Back and current issues available on microfilm and microfiche. Rates on request from Microform Program, ACS.

Chemical & Engineering News (ISSN 0009-2347) is published weekly except for the last week in December by the American Chemical Society at 1155—16th St., N.W., Washington, D.C. 20036. Second-class postage paid at Washington, D.C., and additional mailing offices. POSTMASTER Send address changes to Chemical & Engineering News, Membership & Subscription Services, P.O. Box 3337, Columbus, Ohio 43210. ACS assumes no responsibility for the statements and opinions advanced by the contributors to its publications.

Advertising Management
CENTCOM LTD.
(For list of offices see page 67)

LETTERS

Doctorate required

SIR: I do not believe that the errors about law degrees in my letter (C&EN, May 30, page 3) were of such gravity as to warrant K. Kay Shearin's comment, "The errors . . . should not be uncorrected" (C&EN, Sept. 5, page 3). My letter was in support of a proposal that a doctorate in chemical research be awarded to individuals who had made significant contributions in chemical research, but who had not earned a doctorate through the formal training that is designed to prepare them to conduct such research. The matter of law degrees was included merely to show that the requirements for a doctorate are not immutable; that the doctorate is now awarded to law graduates for the same academic training that until recently yielded only a bachelor's degree. If I had used the correct term "Bachelor of Laws" rather than "Bachelor of Laws and Letters" for the LL.B. degree, the sense of my intended message would in no way have been affected.

Shearin strongly disagrees with my opinion that those who have doctorates are widely looked upon as being at the top of their professions. Would that this were so; there would then be no need to advocate the introduction of the degree proposed by Altamura and others. But one need only look at the advertisements in C&EN for support of my opinion. Among the employment ads for nonacademic positions in the May 5 issue, 14 required a doctorate; none of these offered to waive this in exchange for accomplishments.

Joseph Levine
Emeritus Member
Silver Spring, Md.

New educational paradigm

SIR: David Wagger, in his letter (C&EN, Aug. 22, page 3) suggests that "in order to provide the instructors to teach our future citizens, today's scientific community, of which ACS is a part, must provide from its membership persons who will devote time, effort, and expertise in developing a new educational paradigm in which science and mathematics are stressed appropriately." I believe this is true but that the chemical community may not yet be ready to address these issues.

At this time Purdue has the only division of chemical education within a chemistry department in the U.S. I think the division is trying to provide the types of people that Wagger suggests are needed. There are essentially three types of students in the program. First, there are those who wish to become certified to teach high school. The second consists of those who want to teach chemistry at a small, liberal arts college. Students in the third group are also interested in teaching, but in addition they are interested in researching how students learn (or don't learn) chemistry and trying to improve our teaching practices through this research. Although each group has different interests, as a whole they are attempting to "devote time, effort, and expertise in developing a new educational paradigm."

Each of these three groups works toward a master's degree in chemistry. Those seeking certification generally pursue a nonthesis program consisting of graduate courses in chemistry and education. The two groups interested in careers at the college level take courses in chemistry and education, and work on a thesis project looking at some aspect of how students learn chemistry or how it can be better taught. After completing the master's program, these two groups switch into the education department to work toward a doctorate in science education.

One problem with this approach is that the people completing a doctorate in science education are not accepted as part of today's scientific community in the same way as someone who is completing a doctorate in chemistry. Because they choose to research problems that are nonchemical in nature they are not viewed as equals. Although this may sound like an ideological problem, it translates in the real world into terms of what sorts of positions these graduates obtain.

Out of the four most recently graduated students from this program, two are in tenure-track positions in education departments, and the other two are in nontenure track, temporary teaching positions in chemistry departments. Those chemistry departments seeking chemical educators almost invariably desire candidates with a doctorate in chemistry. I think the people completing the program in science education have greater expertise for developing a new educational paradigm than people completing a program in chemistry. However, those chemistry departments seeking candidates for a position in chemical education would rather hire someone from their own scientific community.

I am trying to circumvent this problem. After completing my master's thesis investigating graduate student problem solving in organic synthesis and watching several of the older graduate students in the chemical education divi-

game," and therefore asked the Japanese the same types of questions Dow executives were asked. He says the delegation did a little hedging of their own in divulging their goals and strategies.

"I don't think this was an expedition to look for joint ventures," Snyder says. "Rather, it was an effort to explore the American and European chemical industries, determine what our priorities are, how we carry out our work, how we look at Japan. The one thing I learned is how far downstream they seem to be interested in. I don't think the typical chemical manufacturer sees himself as diving toward activities like manufacturing for the auto industry as they seem to indicate."

Wil Lepkowski

R&D policy of Reagan Administration examined

With voters going to the polls to choose a new President this week, the American Association for the Advancement of Science thought it a good time to examine how research and development has fared during President Reagan's two terms. The assessment comes in a pamphlet-sized publication entitled "R&D in the 1980s: A Special Report."

The report finds the Reagan Administration's R&D policies to "have been remarkably consistent" over the eight years it has been in power. It has emphasized heavy investment in military R&D, provided substantial increase to nondefense basic research, resisted increases in biomedical research, and proposed reductions in applied research in civilian agencies.

Between fiscal 1980 and fiscal 1988, total federal R&D spending increased an estimated 86% to about $59 billion. Even after adjusting for inflation, this represents an overall constant-dollar increase of 26%, the report says. Leading the way, quite expectedly, is the Defense Department. At the start of the decade, DOD spent about $14 billion on R&D; by fiscal 1988 it was spending over $38 billion. DOD's budget for just one area, tactical R&D, the report notes, is about twice the size of the National Institutes of Health's entire research program.

The National Science Foundation, whose budget the Administration initially wanted to pare back and restructure, according to the report, has benefited from the Administration decision in 1984 that basic research was essential to the nation's economic competitiveness. Thus, after falling in the early part of the decade, the report says NSF's budget rebounded, ultimately rising 74% from 1980 through 1988, or 17% in constant-dollar terms. However, not all of that increase went into basic research because of Congress' emphasis on science and engineering education programs.

NIH, on the other hand, experienced erratic growth during the Reagan years, the report says, noting that Reagan's proposed budgets for NIH never compensated for inflation, and often proposed spending less than was appropriated in the preceding years. It is only because of a beneficent Congress that NIH's budget has doubled since 1980, rising 34% in real terms from 1980 to 1988. The report notes, however, that almost 57% of NIH's cumulative new spending in that period went to AIDS research.

Overall, except for its attitudinal turnaround on NSF, it is apparent from the report that the Administration accomplished most of what it set out to do.

Janice Long

Reagan Administration has been good to basic research

$ billions	1980[a]	1988[b]	% change $ Current	% change $ Constant
Defense R&D[c]	$40.2	$15.0	100%	83%
Development	36.7	12.5	194	99
Applied research	2.6	1.9	38	−7
Basic research	0.9	0.6	50	11
Civilian R&D	18.8	18.7	13	−24
Basic research	8.8	4.2	107	40
Applied research	6.5	5.0	29	−13
Development	3.7	7.5	−50	−66
TOTAL	$59.0	$31.7	86%	26%

a Estimate. b Actual. c Includes Department of Energy defense R&D. Source: American Association for the Advancement of Science

BP Chemicals targets LPG as ethylene source

BP Chemicals is looking to tap North Sea liquefied petroleum gas (LPG) as an ethylene source to replace currently used naphtha. If that happens, an existing cracker at Grangemouth, Scotland, will be modified to use LPG, boosting annual ethylene output there some 250,000 metric tons in four or five years. It will mark the first usage of LPG in the U.K. to make lower olefins.

According to John N. Turnbull, who is responsible for petrochemicals and polymers at BP Chemicals, the policy is to run the company's crackers at full capacity, and meet remaining ethylene needs with purchases on the open market. Most of the ethylene goes to make polyethylene, one of BP Chemicals' major business areas.

"This remains our policy," he says. "But looking ahead, we foresee our ethylene deficit rising to a quarter of a million tons a year. We can't see filling that level of deficit through purchases." He rules out the option of building a new cracker as uneconomic. But he sees a case for adapting and extending one that's already in place.

By 1992, if the planned expansion were not made, BP Chemicals would have capacity for making 270,000 metric tons of ethylene at Grangemouth, and 330,000 metric tons at Baglan Bay in Wales. A further 150,000 metric tons is available from a cracker shared with ICI, bringing the total to 750,000 metric

tons. Its U.K. ethylene needs in that year will reach 760,000 metric tons. Add to that the 240,000 metric tons required to make polyethylene at Antwerp, Belgium, and the ethylene deficit reaches 250,000 metric tons. "It's clear that we can't sustain our present level of ethylene purchases without sacrificing our strong strategic base in the product," Turnbull points out.

Currently, more than half the U.K.'s yearly polyethylene requirements are met by imports, he notes. "It makes economic sense to upgrade LPG rather than export it and bring back the polymer," he reasons. Moreover, he adds, Grangemouth is an ideally suited location to take deliveries of the increasing quantities of LPG arriving from North Sea operations.

And there still is plenty of growth ahead for polyethylene. This year's 7.5 million metric ton demand in Western Europe compares with 5.7 million metric tons five years ago. In 1993, Turnbull projects usage exceeding 9 million metric tons, increasing to more than 11 million metric tons by the turn of the century.

Dermot O'Sullivan

Poll draws portrait of U.S. scientists' views

A rare portrait of U.S. research scientists and their views on scientific and societal issues, including political questions, is drawn in a survey released late last month by Sigma Xi, the scientific honor society, at its annual meeting in Orlando, Fla.

Among the findings:

- U.S. scientists disagree with the nation's science funding and management policies in such key areas as peer review, politically targeted research funding, and support for "Big Science" projects.
- They find their scientific careers fulfilling, have high regard for science and its values, and recommend science as a career.
- They mirror the U.S. public's social and political views.
- Their postcareer and retirement issues are increasingly important.

The survey grew out of Sigma Xi's effort this year to enhance public understanding of science and technology, and builds on its successful 1986 survey. Its aim was to collect information that would improve understanding of scientists by a public that often stereotypes the scientist as a remote and forbidding Dr. Strangelove, notes project director Jack Sommer, the society's chairman of international programs.

The 80-item questionnaire was mailed Aug. 11 to a sample of about 10,000 of the society's 115,000 members. The results reflect 3332 responses received by Sept. 15. Sommer says the sample is representative of Sigma Xi's membership. The sample does not fully represent all scientists and engineers. However, he notes, "no other survey can claim such a comprehensive canvas." The survey canvassed scientists and engineers in more than 160 disciplines from academia, industry, and government.

It shows that scientists are anchored in the U.S. mainstream, he adds. Half participate in religious activities regularly. Majorities oppose decriminalization of narcotics and accept capital punishment as legitimate. The scientists divide evenly between liberal and conservative in political views.

Lack of public understanding of science is the most important issue now facing science, say 40% of the respondents, followed by overpoliticization of research (24%) and interruptions in research funding (21%). Of those with an opinion, 81% say Congress should not target research projects for federal funding, and research funds are "tied too closely to prevailing political priorities and fashions." Congressional "pork barrel" allocations of research funds are condemned by 88% of those taking a position.

Moreover, 64% of those with an opinion launch what Sommer calls "a startlingly intense indictment" of the peer review process for awarding research grants; 32% believe "reviews are marred by cronyism, old boy networks, and insider politics." And 27% say "original, nonmainstream ideas are unlikely to be funded." Fewer than 8% say "peer review works well as it is."

Survey respondents agree with the call of National Academy of Sciences president Frank Press for scientists to set research priorities themselves, so as to present a more coherent appeal for funding to Congress and the public (C&EN, May 2, page 8). When asked to choose research areas for support, participants give top priority (23%) to untargeted individual research awards. Next are biosphere/geosphere systems (19%)—reflecting environmental concern—and acquired immune deficiency syndrome (AIDS) (16%). After that come the Engineering Research Centers and the Science & Technology Centers (13%), and superconducting materials (9%). Ranked lowest are four major national programs: the space station, Strategic Defense Initiative, human genome project, and Superconducting Super Collider. Thus, Sigma Xi members agree with Press in giving highest priority to basic scientific research, training, and education, and to national crises like AIDS, and in assigning lowest priority to "political projects" like the space station and defense R&D.

The survey, "Sketches of the American Scientist," is available for $3.00 from Sigma Xi, 345 Whitney Ave., New Haven, Conn. 06511.

Richard Seltzer

Scientists give low priority to funding Big Science

Research area	% support[a]
Untargeted individual research awards	23%
Biosphere/geosphere systems	19
AIDS (acquired immune deficiency syndrome)	16
Engineering Research Centers and Science & Technology Centers	13
Superconducting materials	9
Space station	6
Strategic Defense Initiative	4
Human genome project	4
Superconducting Super Collider	2
Other[b]	4

a Surveyed scientists were asked to choose the "three best uses of public funds for scientific research" at this time, and results were normalized to total 100%. b Includes substantial support (48%) for health-related research areas. Source: Sigma Xi survey